Adapting to the Impacts of Climate Change:

an Introduction

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Overview

- Charge to Commission
- Defining Adaptation
- Pew Center Brief—Climate Change 101: Adaptation
- Examples
  - Health
  - Wildlife
  - Land use
  - Food supply

Charge to Commission in E.O. 59

Climate Change Action Plan:

1. Inventory the amount of and contributors to Virginia's greenhouse gas emissions, and projections through 2025
2. Evaluate expected impacts of climate change on Virginia's natural resources, the health of its citizens, and the economy, including the industries of agriculture, forestry, tourism, and insurance
3. **Identify what Virginia needs to do to prepare for the likely consequences of climate change**
4. Identify the actions (beyond those identified in the Energy Plan) that need to be taken to achieve the 30% reduction goal and
5. Identify climate change approaches being pursued by other states, regions and the federal government.

Adaptation Defined

The International Panel on Climate Change defines adaptation:

"Adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts."

The Pew Center on Global Climate Change defines adaptation:

"Actions by individuals or systems to avoid, withstand, or take advantage of current and projected climate changes and impacts. Adaptation decreases a system's vulnerability, or increases its resilience to impacts."

The Need to Plan for Adaptation

- Limits on emissions will not be enough, or happen soon enough, to avoid all impacts of climate change.
- Reducing emissions will decrease the magnitude of global warming and its related impacts. But carbon dioxide and other greenhouse gases can remain in the atmosphere for decades or centuries after they are produced.
- Adaptation efforts are necessary to reduce both the cost and severity of both mitigation and climate change impacts for decades to come.

Impacts Expected in Virginia

- **Presentation: "Impacts of Climate Change on Coastal Virginia and Chesapeake Bay"**
  - Higher coastal water levels and greater salinities
  - Shoreline erosion and submergence
  - Increasing nutrient inputs, decreases in oxygen content of estuarine waters, decreasing pH
  - Significant ramifications for coastal, bay and estuarine plants, animals, food webs and ecosystems
- **Presentation: "The Potential Impacts of Global Sea Level Rise on Transportation Infrastructure"**
  - Norfolk Naval Facilities at risk for sea level rise
  - VA roads, rail, airports, and ports at risk
  - Transportation infrastructure and long-term planning for climate change risks necessary
- **Presentation: "National Security and the Threat of Climate Change"**
  - VA Beach: tourist destination that brings 11,400 jobs and $895 million in revenue
  - VA Beach: commercial fishing industry worth more than $130 million (2005)
  - 374 square miles of Virginia lie less than five feet above sea level

Pew Center Brief
Climate Change 101: Adaptation

Choose adaptation options based on a careful assessment of efficacy, risks and costs.

- No-regret: Actions that make sense or are worthwhile regardless of additional or exacerbated impacts from climate change.
  - Example: protecting/restoring systems that are already vulnerable or of urgent concern for other reasons.

- Profit/opportunity: Actions that capitalize on observed or projected climatic changes.
  - Example: shifting to different crops that are better suited to changing climatic conditions.

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Climate Change 101: Adaptation

Choose adaptation options based on a careful assessment of efficacy, risks and costs.

- "Win-win:" Actions that provide adaptation benefits while meeting other social, environmental, or economic objectives, including climate change mitigation.
  - Example: improving the cooling capacity of buildings through improved shading or other low-energy cooling solutions.

- Low-regret: Measures with relatively low costs for which benefits under climate change scenarios are high.
  - Example: incorporating climate change into forestry, water, and other public land management practices and policies, or long-term capital investment planning.

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Climate Change 101: Adaptation

Choose adaptation options based on a careful assessment of efficacy, risks and costs.

- Avoiding unsustainable investments: Policies or other measures that prevent new investment in areas already at high risk from current climatic events, where climate change is projected to exacerbate the impacts.
  - Example: prohibiting new development in flood-prone areas where sea-level rise is increasing and protective measures are not cost effective.

- Averting catastrophic risk: Policies or measures intended to avert potential or eventual catastrophic events—i.e., events so severe or intolerable that they require action in advance based on available risk assessment information.
  - Example: relocating Alaskan villages in areas at or near sea-level with projected sea-level rise and increasing severe weather events.

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Climate Change 101: Adaptation

- Adaptation measures at the local level:
  - Local actions include:
    - desalinating freshwater sources;
    - protecting infrastructure and communities from flooding, erosion and more severe weather events;
    - and preparing for more severe water shortages and droughts.
  - These initiatives and others may be privately funded or managed, or they may be the responsibility of municipal, emergency response or other agencies.

Best Practices Examples

BEST MANAGEMENT PRACTICES			
Climate Event	Preparedness Goal	Adaptation Method	Example of Application
Natural Hazards and Land Use			
Flood and stormwater runoff	Reduce impervious surface	Increase density of development	Smart Growth; Urban Growth Boundaries; Transfer of Development Rights (TDR)
Potential Water Challenges			
Decreased water quality	Reduce pollution and sediment in stormwater runoff	Bioretention areas to capture heavy runoff	Low-Impact Development (LID) Measures

Best Practices Examples

BEST MANAGEMENT PRACTICES			
Climate Event	Preparedness Goal	Adaptation Method	Example of Application
Agricultural Challenges			
Drought	Improve agricultural water supply and use	Promote efficient irrigation technologies	Technology such as energy-efficient electric motors and micro-irrigation systems
Sea-Level Rise			
Sea Level Rise	Reduce effects of increased water salinity	Corrosion resistant pipes; physical barriers above- and below- ground; retrieve water supply up-river	EPA and Delaware River Basin Commission Report

Example: Human Health

Impacts may include:

- Severe weather events, floods, heat waves
  - injuries, illnesses, deaths
- Changes in vector-borne illness, zoonotic diseases and exposures to toxic substances
- Waterborne and airborne diseases and/or allergic or respiratory illnesses or conditions; threats to food and water supplies
- Harmful algal blooms (HABs)
- Mass migration/evacuation

Example: Human Health

- Public Health Preparedness
  - Occurs in the face of scientific uncertainty
    - influenza pandemic
    - terrorist attack
    - hurricane
- Risk Management
  - Systematic ongoing efforts to identify and reduce risks to health

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Example: Human Health

- **VDH Emergency Preparedness and Response Program (EP&R)**
  - Preparedness and response to all emergencies
    - Availability to respond 24/7
  - Rapid response to outbreaks
  - Build public health infrastructure
    - Increase/enhance local capacity - planners and epidemiologists in all 35 health districts
    - Establish regional response teams
  - Potential to address:
    - Extreme weather events, heat waves/stress
      - Surge at hospitals
    - Disease outbreaks – local planners, epidemiologists
    - Large-scale communication efforts through HAN
      - Emergency communications to vulnerable populations
    - Training

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Example: Wildlife

Expand Into Virginia

Have less habitat available in Virginia

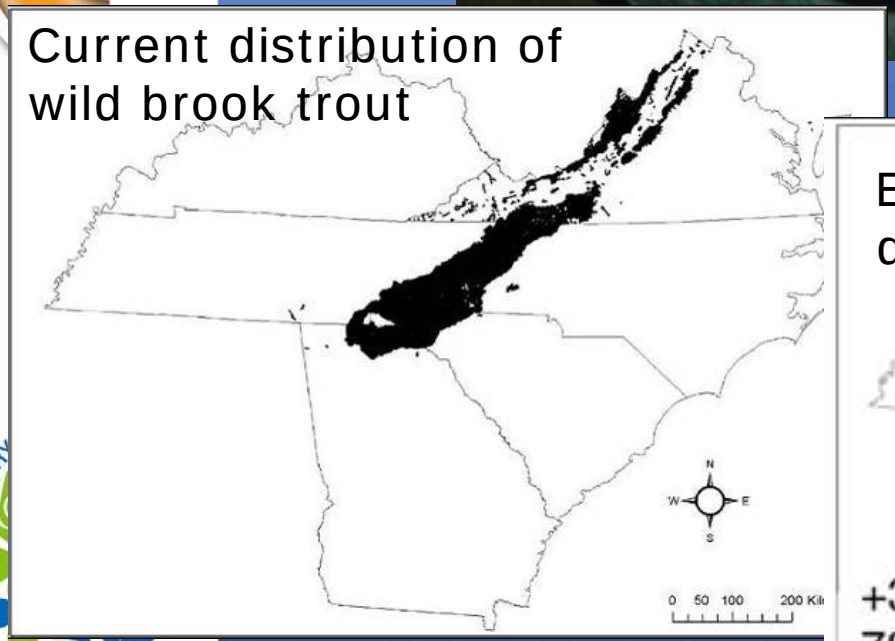
Will be extirpated but survive elsewhere

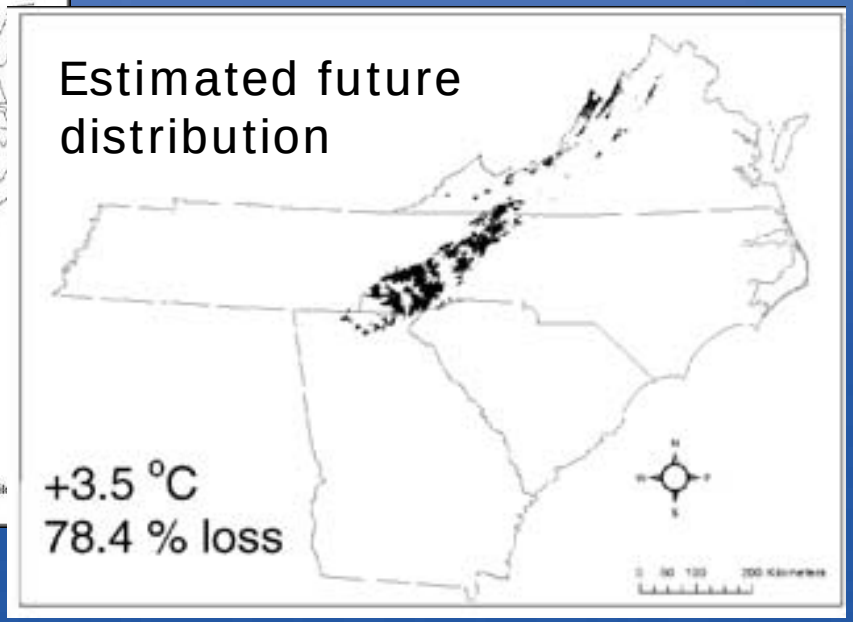
Go extinct

Example: Wildlife

- Goals for managing wildlife with a changing climate:
  - Minimize the number of extinctions
  - Facilitate the gradual migration of species
  - Be efficient and cost effective
- Strategies:
  - Triage – focus efforts and resources on species that can be conserved.
  - Conserve and manage habitats, including corridors that provide connectivity
  - Use adaptive management process to design, implement, monitor, and adapt conservation actions

Example: Wildlife





From: Flebbe et al. 2006

Example: Land Use

- Future development
  - Steer away from high-hazard zones
  - Consider climate change impacts in designating conservation areas
- Infrastructure planning

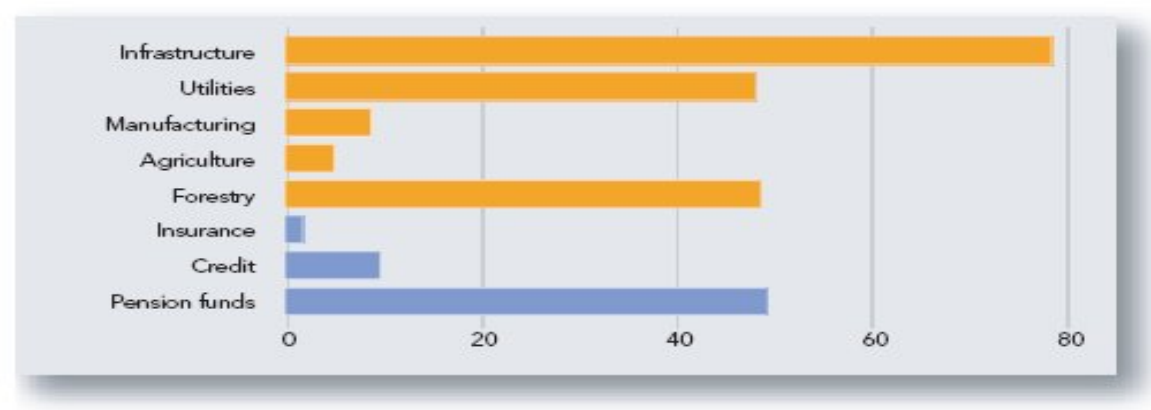


Figure 4

Forward Commitment period by sector (years)

Source: Andlug Consulting

Example: Land Use

- Managed Retreat
  - Land Planning – local and regional growth areas and natural resource/conservation areas
  - Relocation of existing buildings in hazard areas
  - Develop new building codes & envelopes
- Protect
  - Hard structures – dikes and levees
  - Soft protection – dune and wetland restoration/creation
- Accommodate
  - Monitor sea level rise, early warning, & evacuation.
  - Modification of existing land use
  - Strict land use regulation in hazard areas

Example: Land Use

Alaska's experience

- Increased damage to coastal communities from storms and sea surges, made more vulnerable as a result of less and thinner sea ice, which used to provide natural protection from fall storms
- Failing support for buildings, roads, runways and other infrastructure due to melting permafrost
- Increased risks of fuel spills and other accidents from increased shipping and other activity in the Arctic and Aleutians resulting from less sea ice and better access

Example: Land Use

Alaska's experience

- The costs of relocation or protection structures are very high
  - In the most at-risk villages of Kivalina, Newtok and Shishmaref, a technical analysis study in 2006 found each has 10-15 years before erosion impacts critical infrastructure,
  - The cost to move each village would range from $80 million to $200 million
- Other communities that are at risk from coastal erosion, flooding and wild land fires
- Federal emergency funding prioritizes areas of greater population and addressing the aftermath of disasters
- There is a lack of funds for planning, relocation and building structures to prevent disasters

Example: Land Use

Governor's COMMISSION on CLIMATE CHANGE

VIRGINIA

Kivalina

Kivalina

Kivalina

VIRGINIA SECRETARY of NATURAL RESOURCES

Example: Food Supply

According to the U.N. Food and Agriculture Organization, mitigation and adaptation often go hand in hand in the food and agriculture sector:

Mitigating:

- Reduce emissions of carbon dioxide and other greenhouses gases, e.g., through a reduction in the rate of land conversion and controlling wildfires
- Reduce emissions of methane and nitrous oxide, e.g., through improved nutrition for ruminant livestock and more efficient management of livestock waste
- Sequestering carbon, e.g., through improved soil organic matter management such as conservation agriculture involving permanent organic soil cover with minimal disturbance.

Adapting:

- Proper risk management techniques to protect food supplies and livelihood from weather events
- More efficient water management techniques to avoid disruptions in food supplies due to temperature and precipitation changes
- Protect ecosystems through environmental services such as planting forests or other cellulose biomass materials on degraded or marginal lands and carbon sink tree plantings.